In the examples 11 to 14, the ratio (Sm_2O_3 / Al_2O_3) was about 0.2 in the sintered bodies. The volume resistivity at room temperature of each sintered body was as low as 1×10^9 Ω・cm to 1×10^{11} Ω・cm. The activation energies from room temperature to 300 ℃ were as low as 0.33 to 0. 36 eV. The other properties were shown in Fig. 5.

As shown above, when Al_2O_3 was added into raw material, it is still possible to attain a low resistivity and low activation energy by adjusting the amount of added Sm_2O_3 so that the ratio (Sm_2O_3 / Al_2O_3) of the sintered body falls within a predetermined range.

(Experiment B)

(Confirmation of conductive mechanism and conductive path in the sintered bodies according to the invention)

The current distribution analytic images of the sintered body according to the example 7, taken by an atomic force microscope (AFM), were shown in Figs. 8 and 9. The test sample has a shape of a plate with dimensions of 2 mm × 3 mm ×0.2 mm. The face of the sample for current distribution analysis was polished. The analysis was carried out using a model "SPM stage D 3100" (probe type "DDESP") supplied by Digital Instruments. The measurement was performed on contact AFM current measurement mode. A direct current (DC) bias was applied on the lower face of the sample and the current distribution on the polished face was measured using the probe.

The DC bias in Fig. 8 was + 18 V and the visual field was 100 μm × 100 μm. The current is larger in a white and bright region, indicating that the conductivity is high. As can be seen from the figure, current flow forms a kind of network microstructure. Therefore, the microstructure contains network-like continuous phase with a low resistivity.

Fig. 9 shows the current distribution in the central region of the

image of Fig. 8. DC bias was +12 V and visual field was 20 μm×20 μm. Fig. 10 shows a backscattering electron image of the same visual field as Fig. 9, as well as crystalline phases obtained by TEM (transmission electron microscope). According to the TEM analysis, it is confirmed that SmAl11O18 constitutes at least a part of the network microstructure and at least a part of SmAlO3 phase is present as isolated phase.

Conductive mechanism and conductive path in the sintered body according to the example 7 is made clear, by comparing Figs. 9 and 10 with each other. That is, bright and white regions in the current distribution of Fig. 9 (regions of larger current flow) correspond with $SmAl_{11}O_{18}$ phase constituting the network microstructure formed along intergranular phase shown in Fig. 10. It is thereby confirmed that $SmAl_{11}O_{18}$ phase has a low resistivity and thus forms conductive path. $SmAlO_3$ phase is dark in the current distribution image, indicating a low current and relatively high resistivity.

In the example 7, $SmAl_{11}O_{18}$ phase is continuous along the intergranular phase of AlN grains of the sintered body (along the outer surfaces of the grains), forming a kind of network microstructure. Apparently, if another phase made of a samarium-aluminum complex oxide other than $SmAl_{11}O_{18}$ forms continuous network microstructure, such microstructure contributes to the reduction of volume resistivity of an aluminum nitride sintered body. Such complex oxide includes $(Sm, A) (Al, B)_{11} (O, C)_{18}$. "A" represents an element replacing a part of samarium site, "B" is an element replacing a part of aluminum site, and "C" is an element replacing a part of oxygen site. "A", "B" and "C" include the following elements.

"A" includes the second rare earth element other than samarium as described above. "B" includes Mg, Ga, Ti, Fe, Co, V, Cr, Ni or the like. "C" includes N or the like.

(Experiment C: Examples 15 to 21: Reduction of lightness of surface color of aluminum nitride sintered body)

Aluminum nitride sintered bodies were produced substantially same as the experiment "A". The formulation of raw material in the examples 15 to 19 was same as that in the example 7. The formulation of raw material in the examples 20 and 21 was same as that in the example 12. TiO2 (a purity of 99.9 percent : a mean particle diameter of not higher than 1 μm) was added to the raw material of each example in a predetermined amount shown in table 6 as a blackening agent. The manufacturing and evaluating processes were same as those in the example 7.

Table 6 shows the formulation of raw material, sintering conditions, results of chemical analysis of elements in the sintered body, and the converted contents of metal elements in each sintered body according to each example. Table 7 shows the properties of each of the resulting sintered bodies. In table 6, an amount of added TiO_2 is represented as an amount (mole percent) calculated on the provision that total of amounts of AlN, Sm2O3 and Al2O3 is 100 mole percent. The content of Ti in each sintered body was determined by an inductively coupling plasma (ICP) spectrometry. The lightness of the surface color was determined according to "JIS Z 8721".